Project 2: CNN-s

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Outline

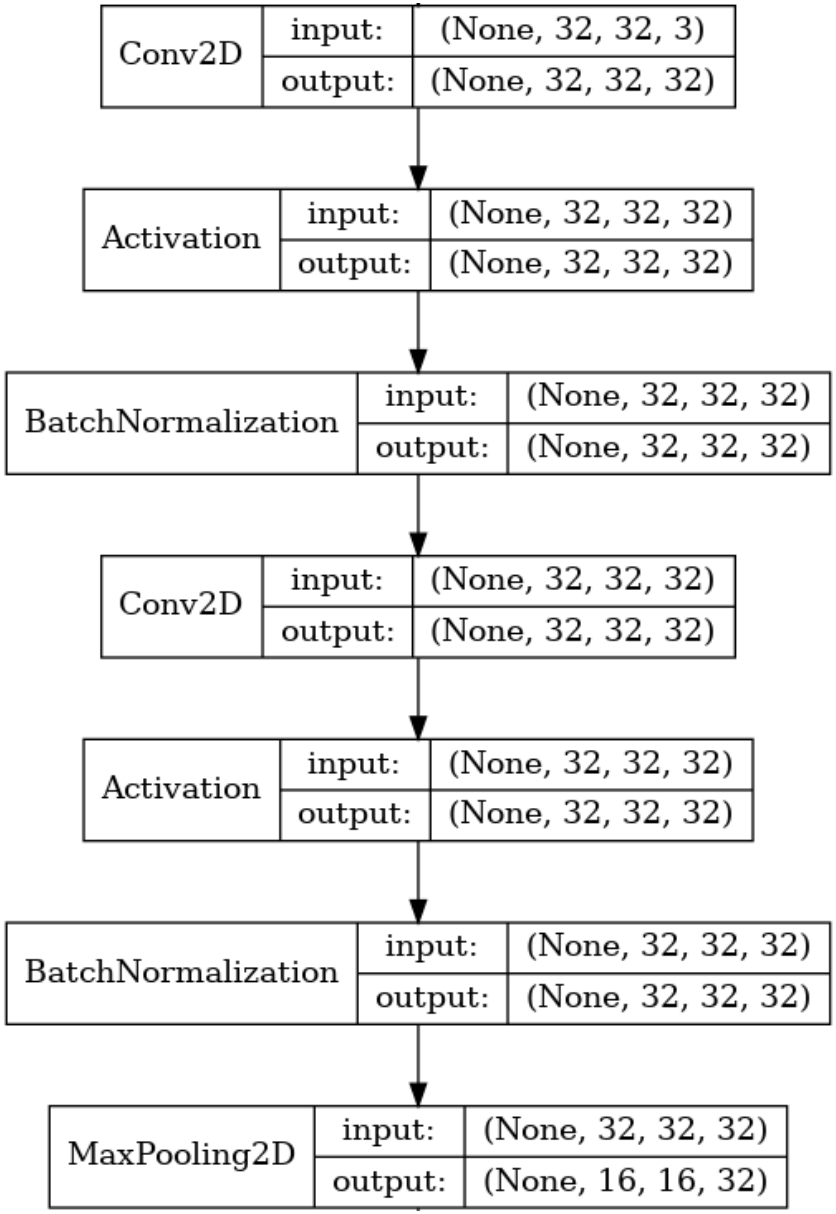
Project description

The aim of the second project was to explore different techniques of building deep neural networks for image classification.

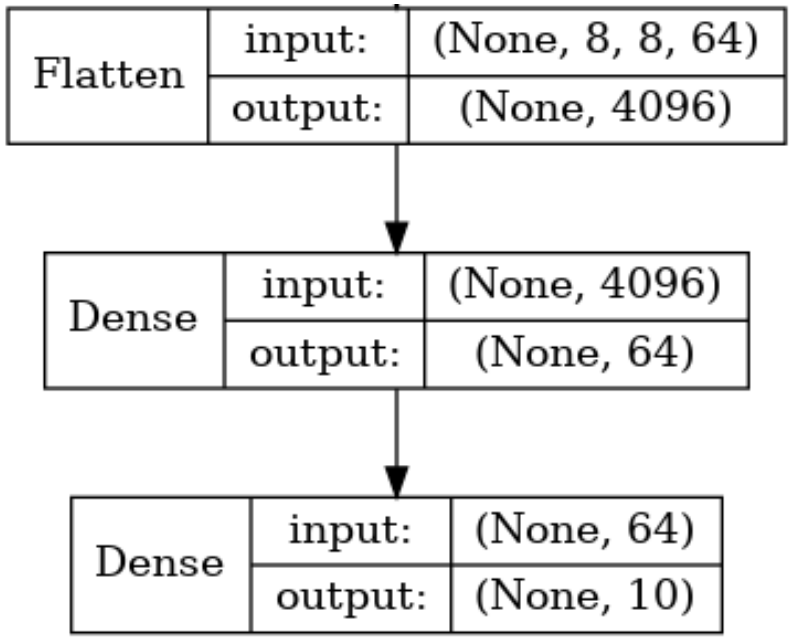
The dataset used for the experiments was cifar10.

We trained different models and used both Keras and Pytorch.

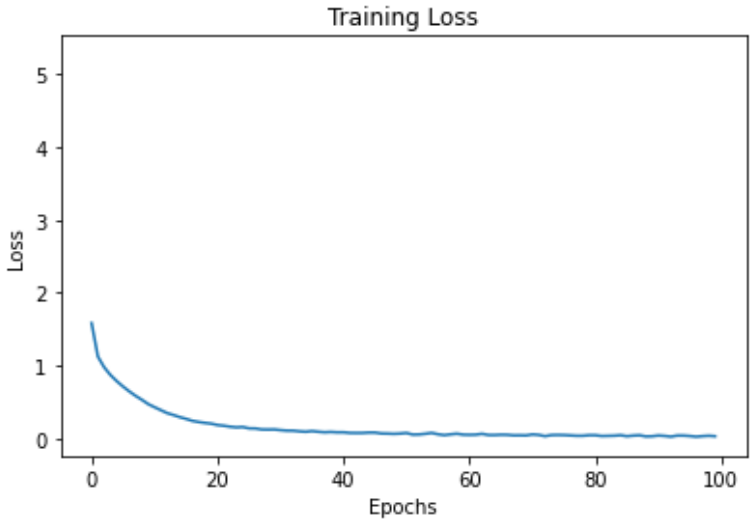
VGG nets

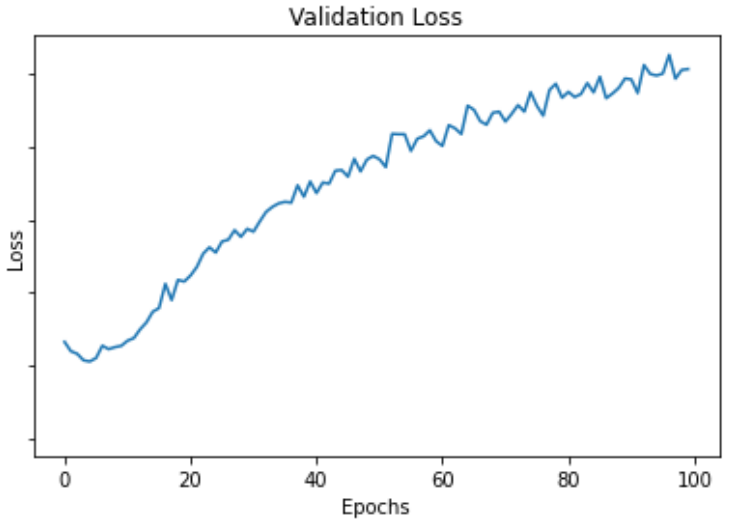

Conv2D
input: (None, 32, 32, 3)
output: (None, 32, 32, 32)
Activation
input: (None, 32, 32, 32)
output: (None, 32, 32, 32)
BatchNormalization
input: (None, 32, 32, 32)
output: (None, 32, 32, 32)
Conv2D
input: (None, 32, 32, 32)
output: (None, 32, 32, 32)
Activation
input: (None, 32, 32, 32)
output: (None, 32, 32, 32)
BatchNormalization
input: (None, 32, 32, 32)
output: (None, 32, 32, 32)
MaxPooling2D
input: (None, 32, 32, 32)
output: (None, 16, 16, 32)

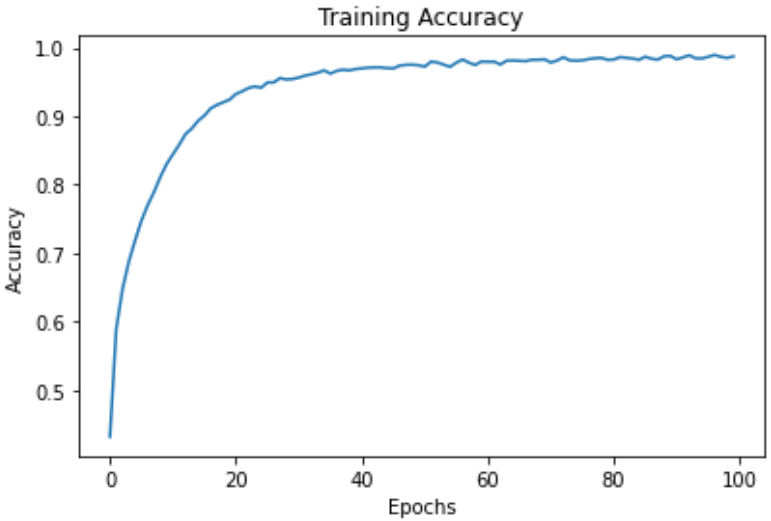
VGG nets

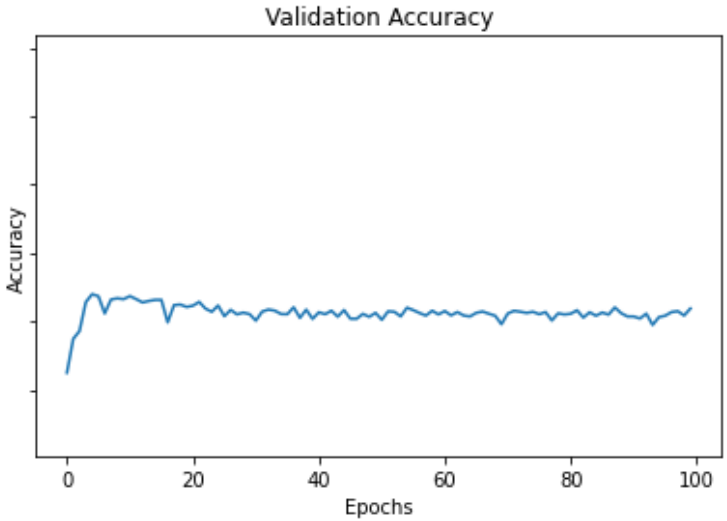

Flatten
input: (None, 8, 8, 64)
output: (None, 4096)
Dense
input: (None, 4096)
output: (None, 64)
Dense
input: (None, 64)
output: (None, 10)

VGG nets

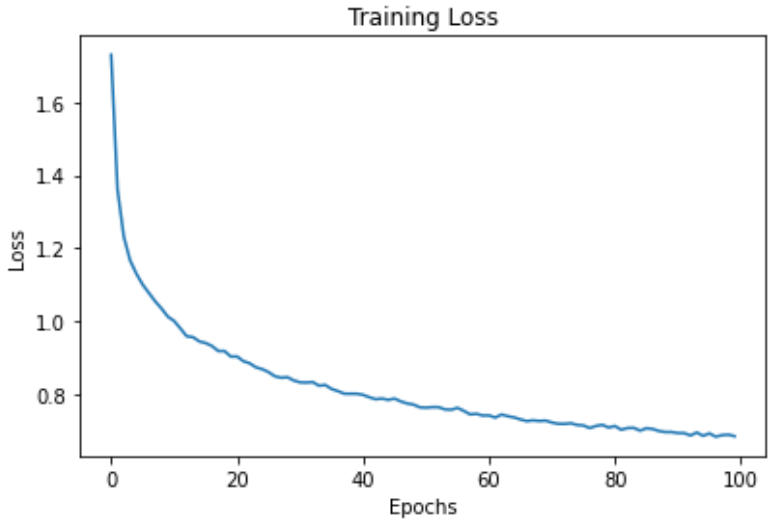

Training Loss
Loss
Epochs
0
1
2
3
4
5
0
20
40
60
80
100

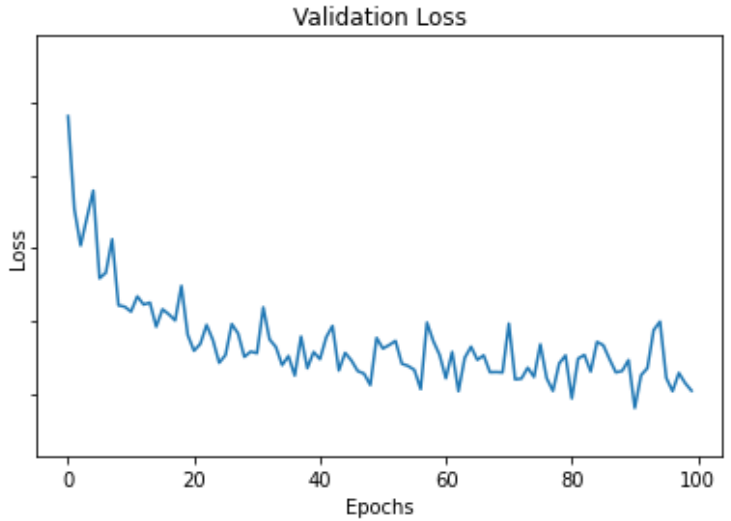

Validation Loss
Loss
Epochs
0
20
40
60
80
100

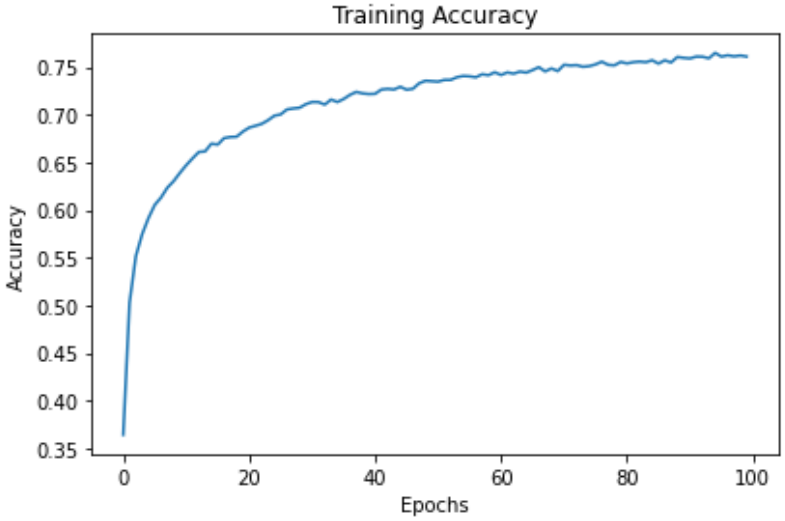

Training Accuracy
Accuracy
Epochs
0.5
0.6
0.7
0.8
0.9
1.0
0
20
40
60
80
100

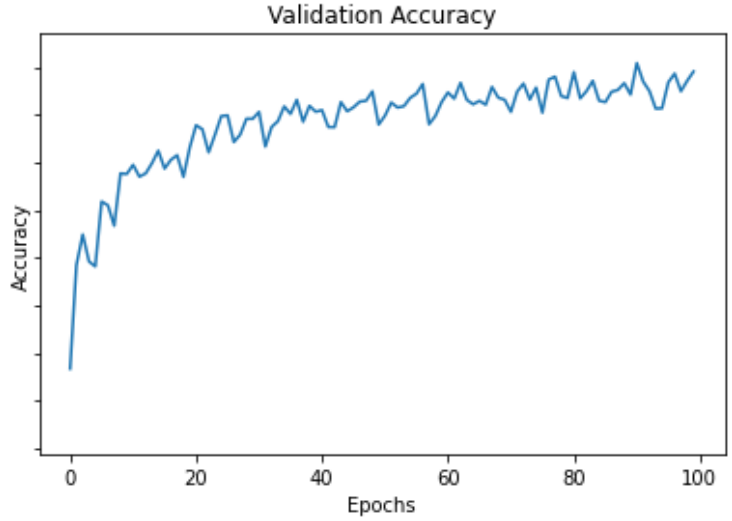

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets

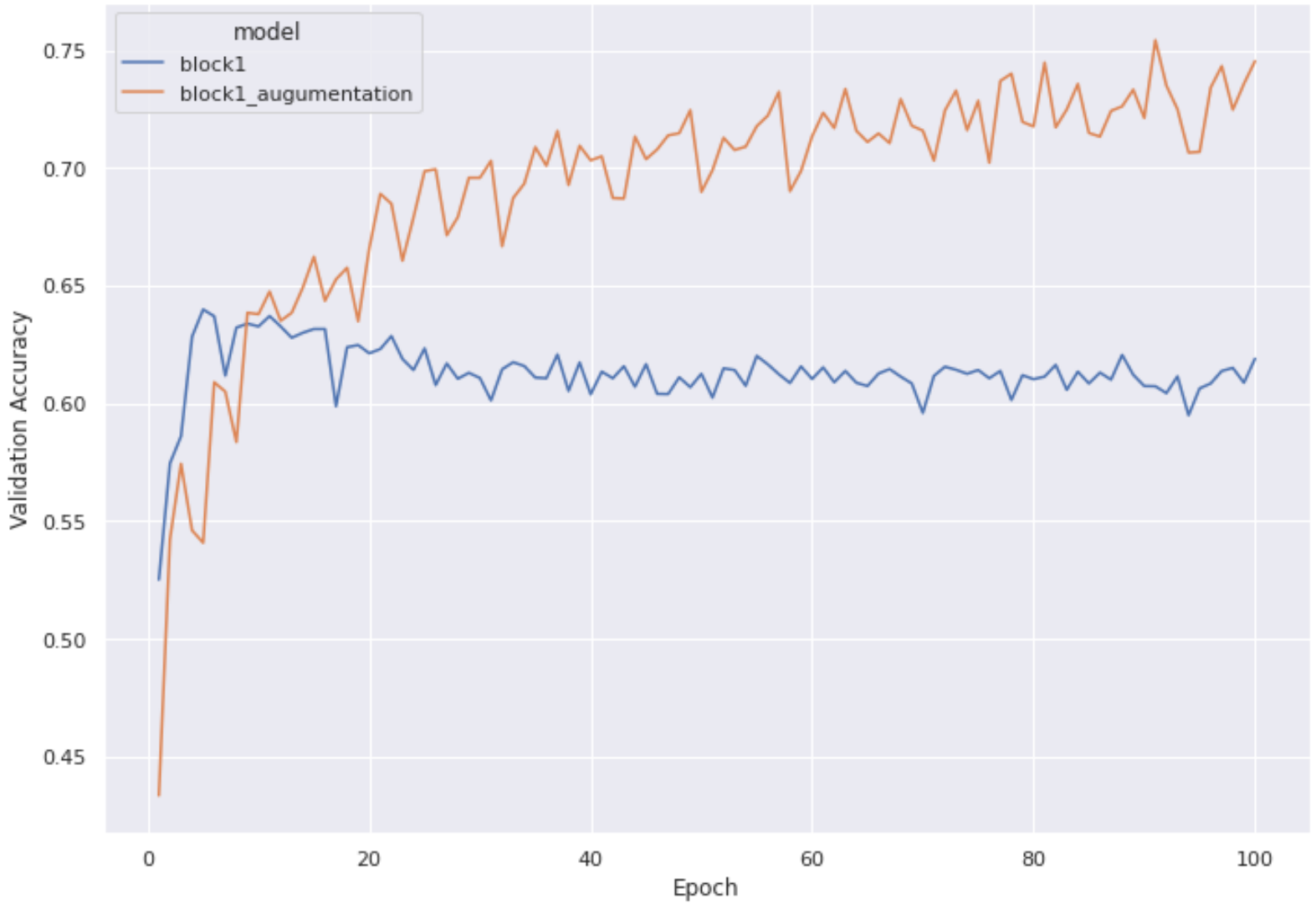

Training Loss
Loss
Epochs
1.6
1.4
1.2
1.0
0.8
0
20
40
60
80
100


Validation Loss
Loss
Epochs
0
20
40
60
80
100

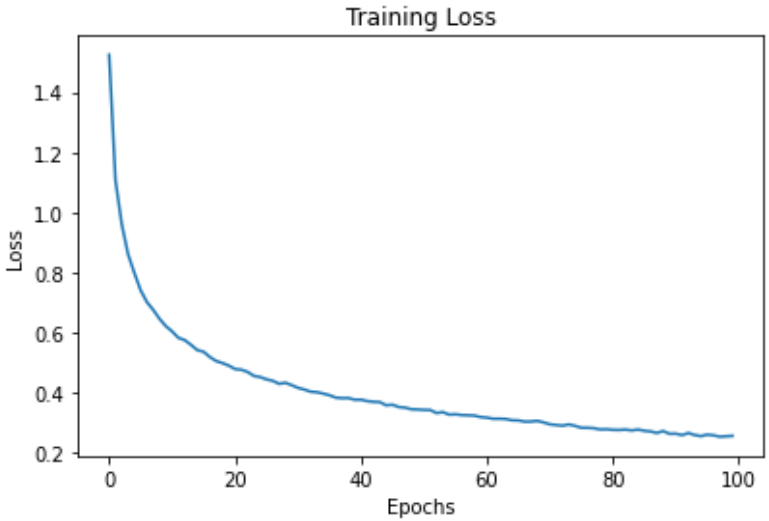

Training Accuracy
Accuracy
Epochs
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0.40
0.35
0
20
40
60
80
100

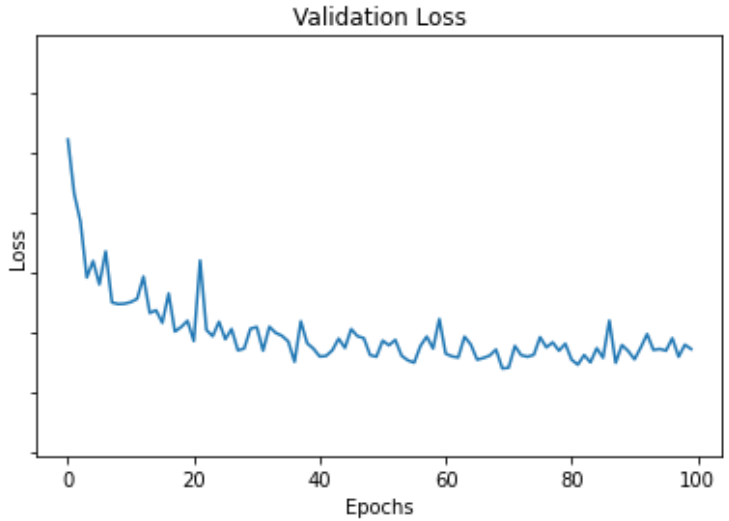

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

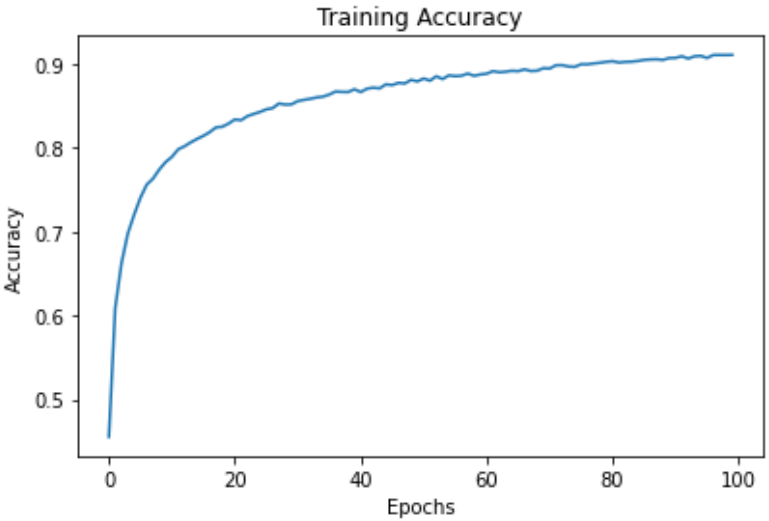
VGG nets

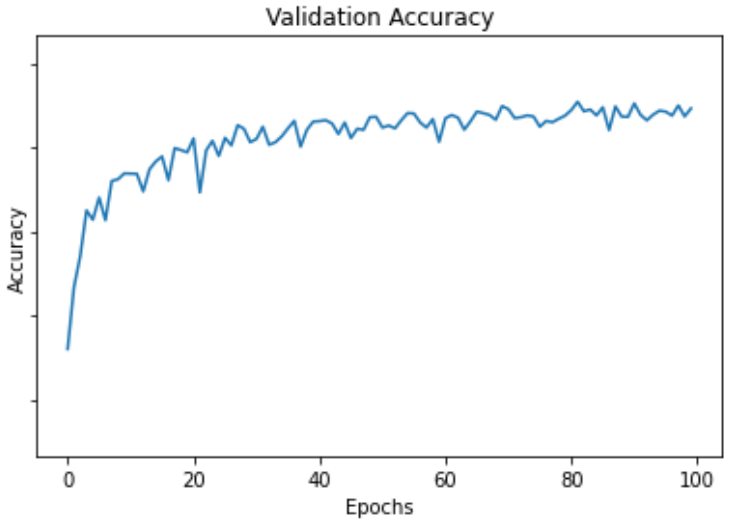

model
block1
block1_augumentation
Validation Accuracy
0.75
0.70
0.65
0.60
0.55
0.50
0.45
0
20
40
60
80
100
Epoch

VGG nets

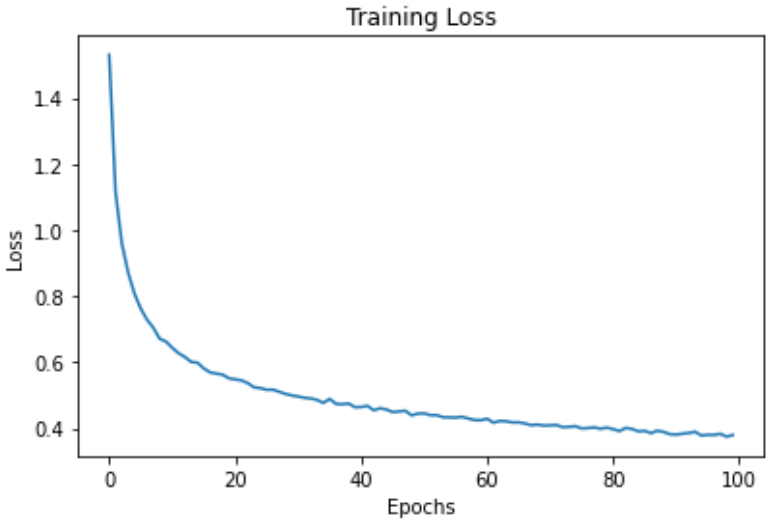

Training Loss
Loss
Epochs
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
20
40
60
80
100

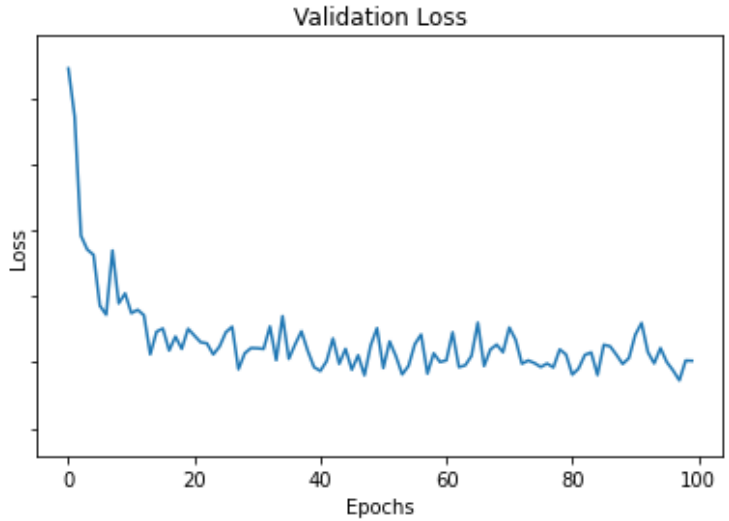

Validation Loss
Loss
Epochs
0
20
40
60
80
100

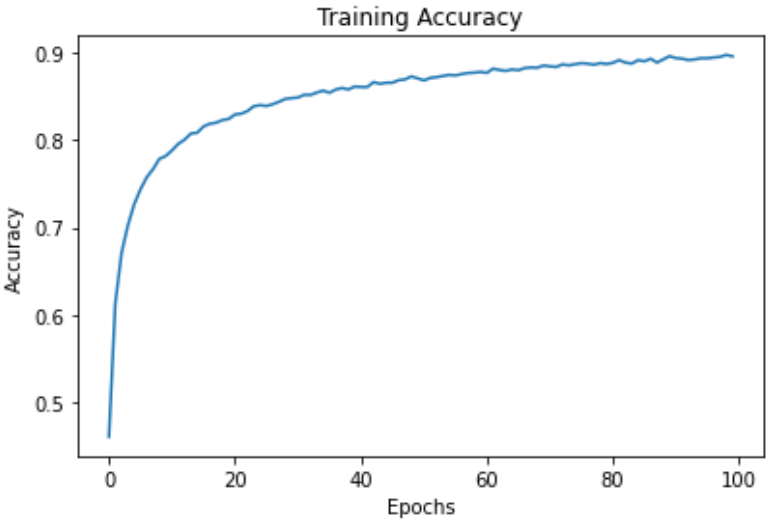

Training Accuracy
Accuracy
Epochs
0.9
0.8
0.7
0.6
0.5
0
20
40
60
80
100

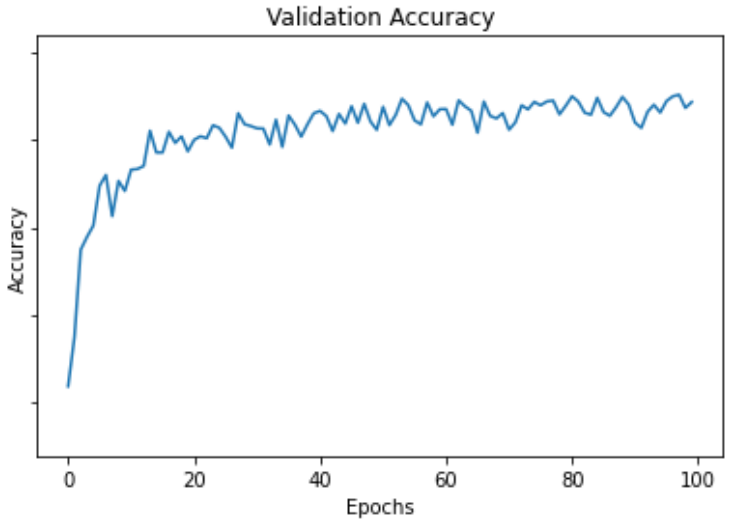

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets

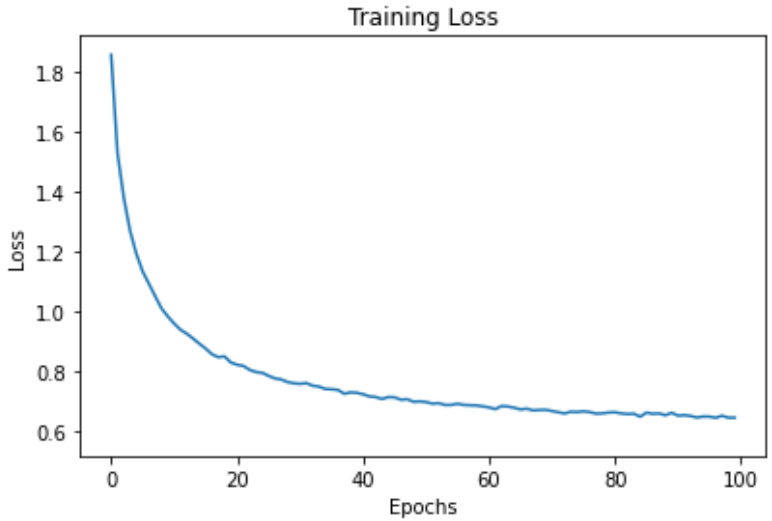

Training Loss
Loss
Epochs
1.4
1.2
1.0
0.8
0.6
0.4
0
20
40
60
80
100

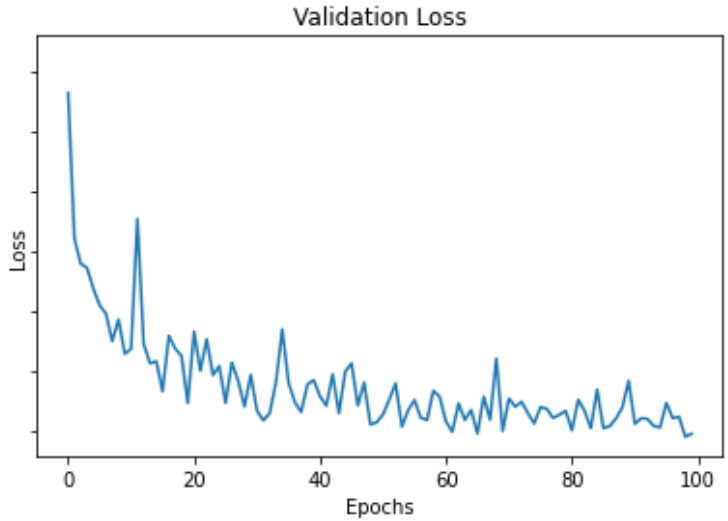

Validation Loss
Loss
Epochs
0
20
40
60
80
100

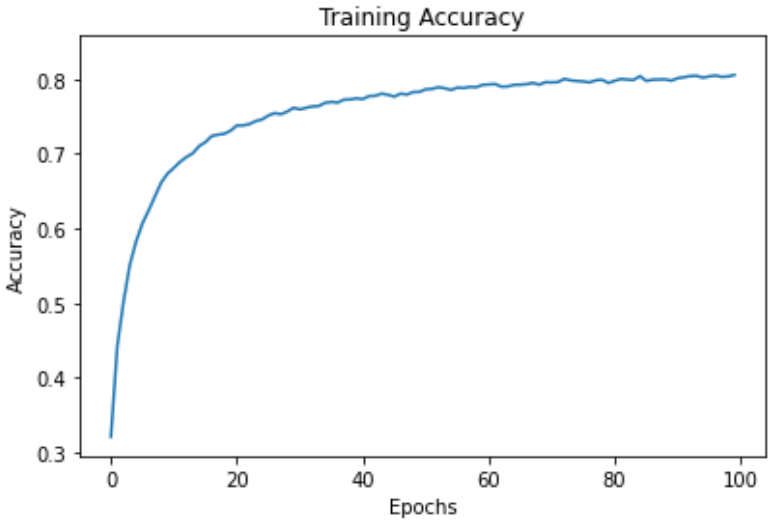

Training Accuracy
Accuracy
Epochs
0.9
0.8
0.7
0.6
0.5
0
20
40
60
80
100

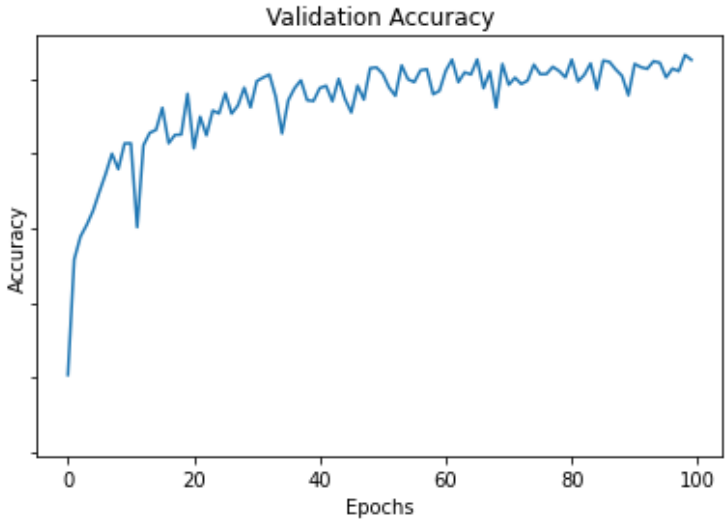

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets


Training Loss
Loss
Epochs
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0
20
40
60
80
100


Validation Loss
Loss
Epochs
0
20
40
60
80
100


Training Accuracy
Accuracy
Epochs
0.8
0.7
0.6
0.5
0.4
0.3
0
20
40
60
80
100


Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

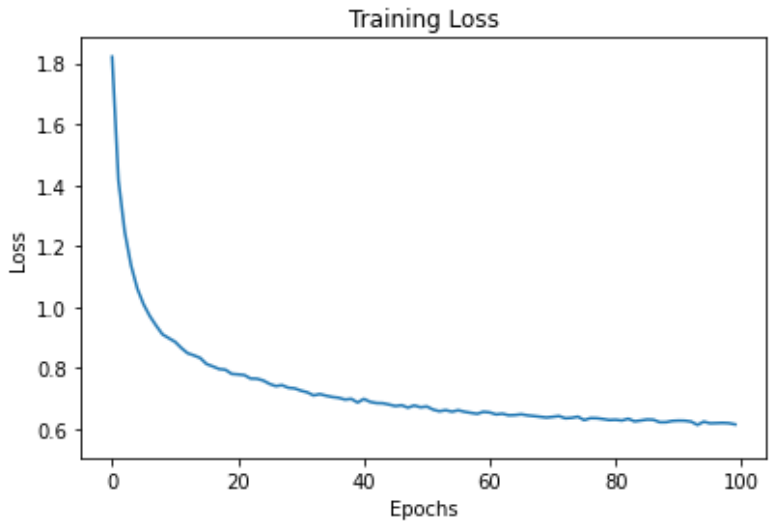
VGG nets

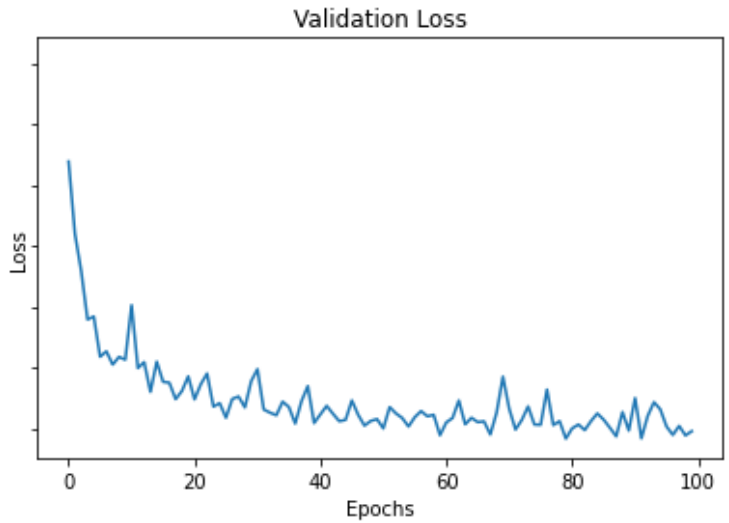

Diffrence between Validation and Training Loss
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
−0.3
0
20
40
60
80
100
Epoch
model
block2_augumentation
block2_augumentation_l2
block2_augumentation_l2_dropout

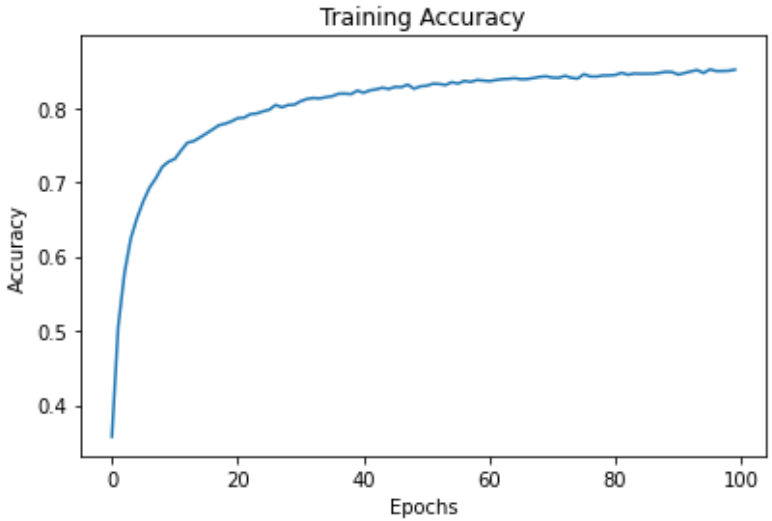
VGG nets

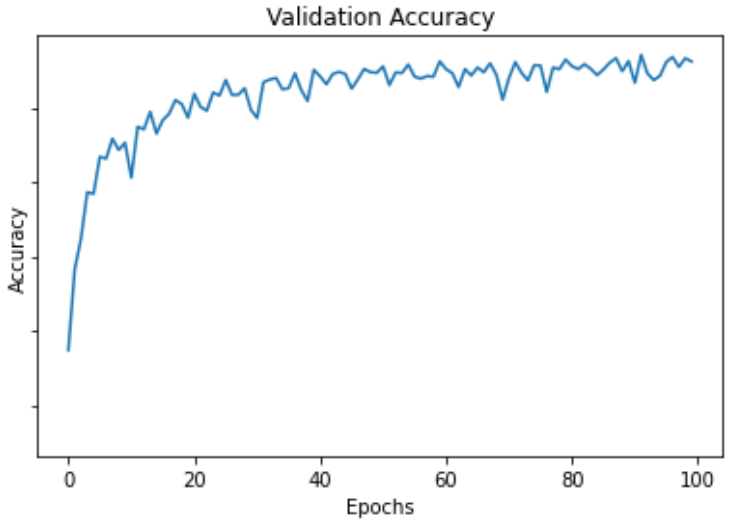

Validation Accuracy
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100
Epoch
model
block2_augumentation
block2_augumentation_l2
block2_augumentation_l2_dropout

VGG nets

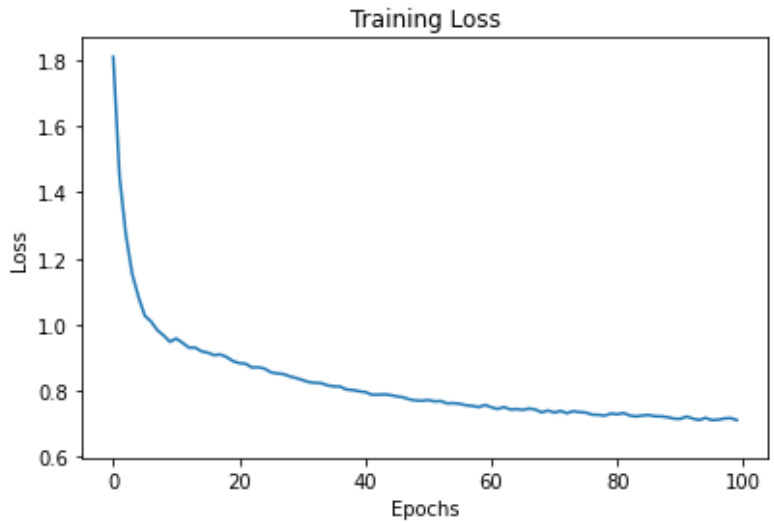

Training Loss
Loss
Epochs
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0
20
40
60
80
100

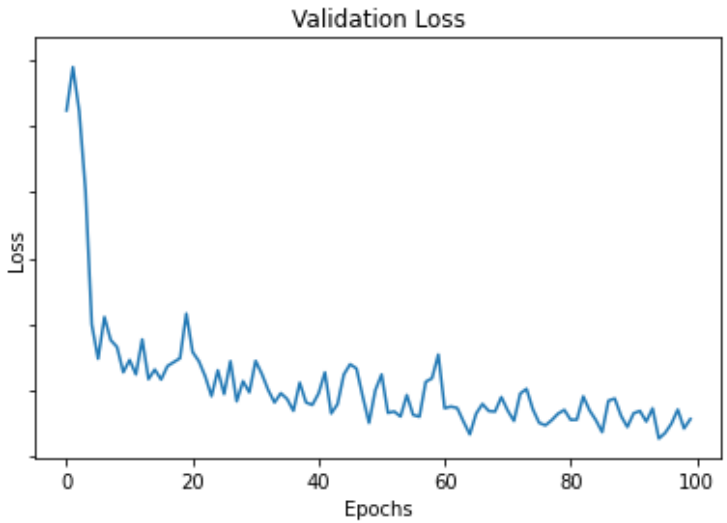

Validation Loss
Loss
Epochs
0
20
40
60
80
100

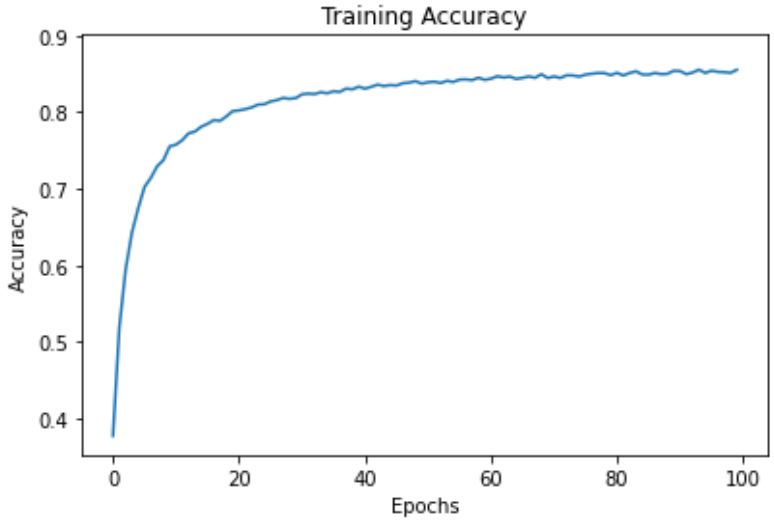

Training Accuracy
Accuracy
Epochs
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100

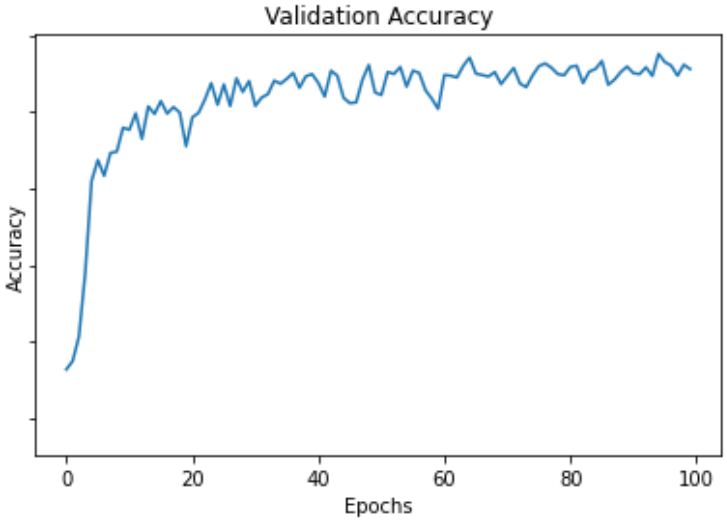

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets

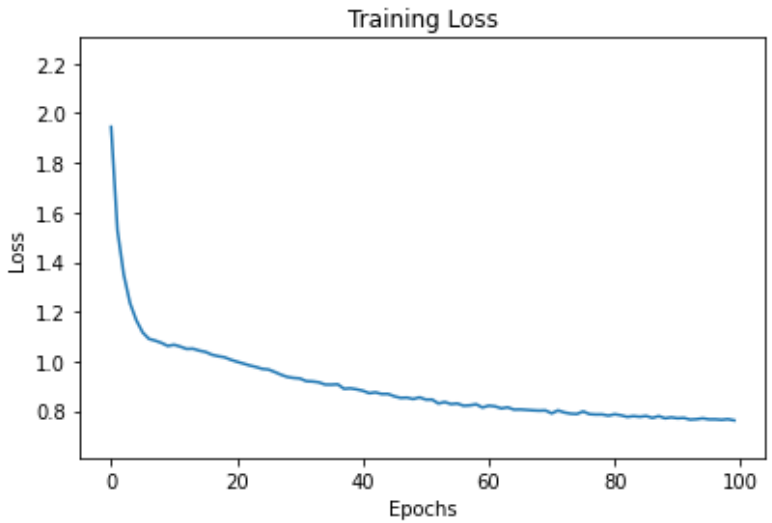

Training Loss
Loss
Epochs
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0
20
40
60
80
100

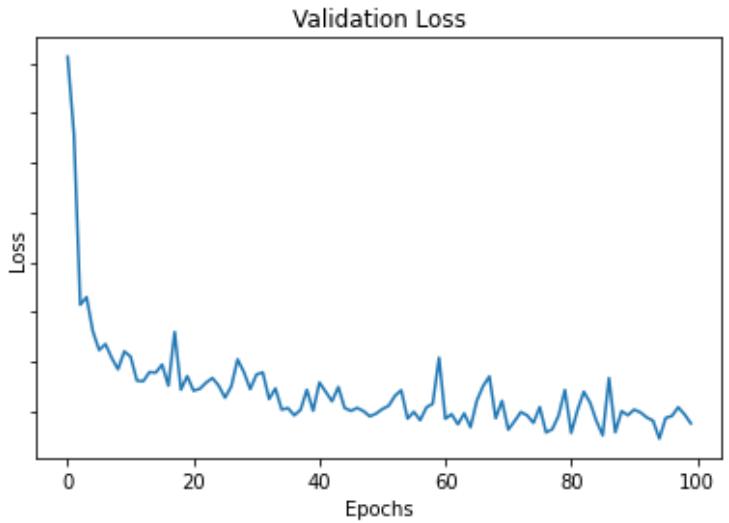

Validation Loss
Loss
Epochs
0
20
40
60
80
100

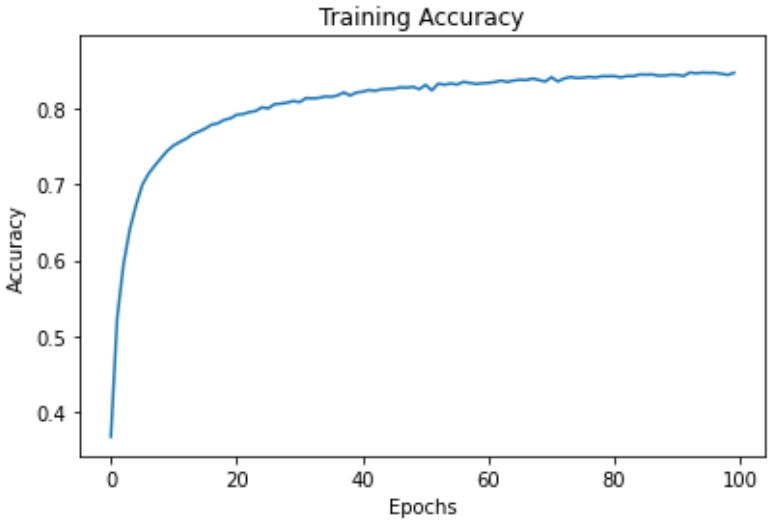

Training Accuracy
Accuracy
Epochs
0.9
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100

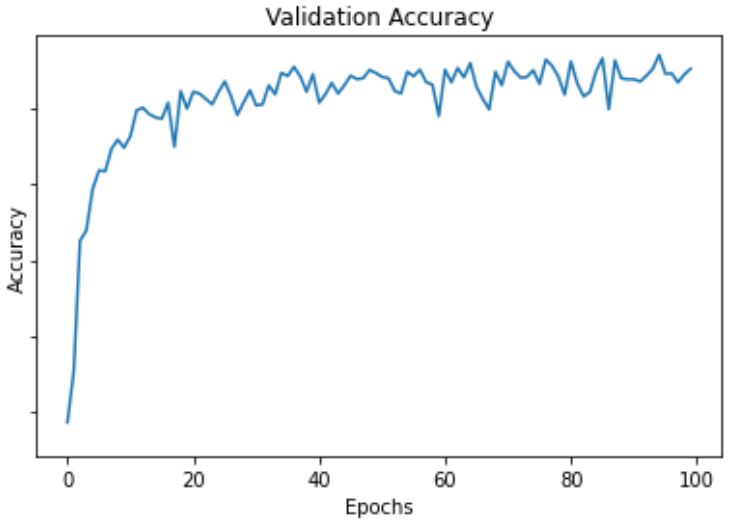

Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets

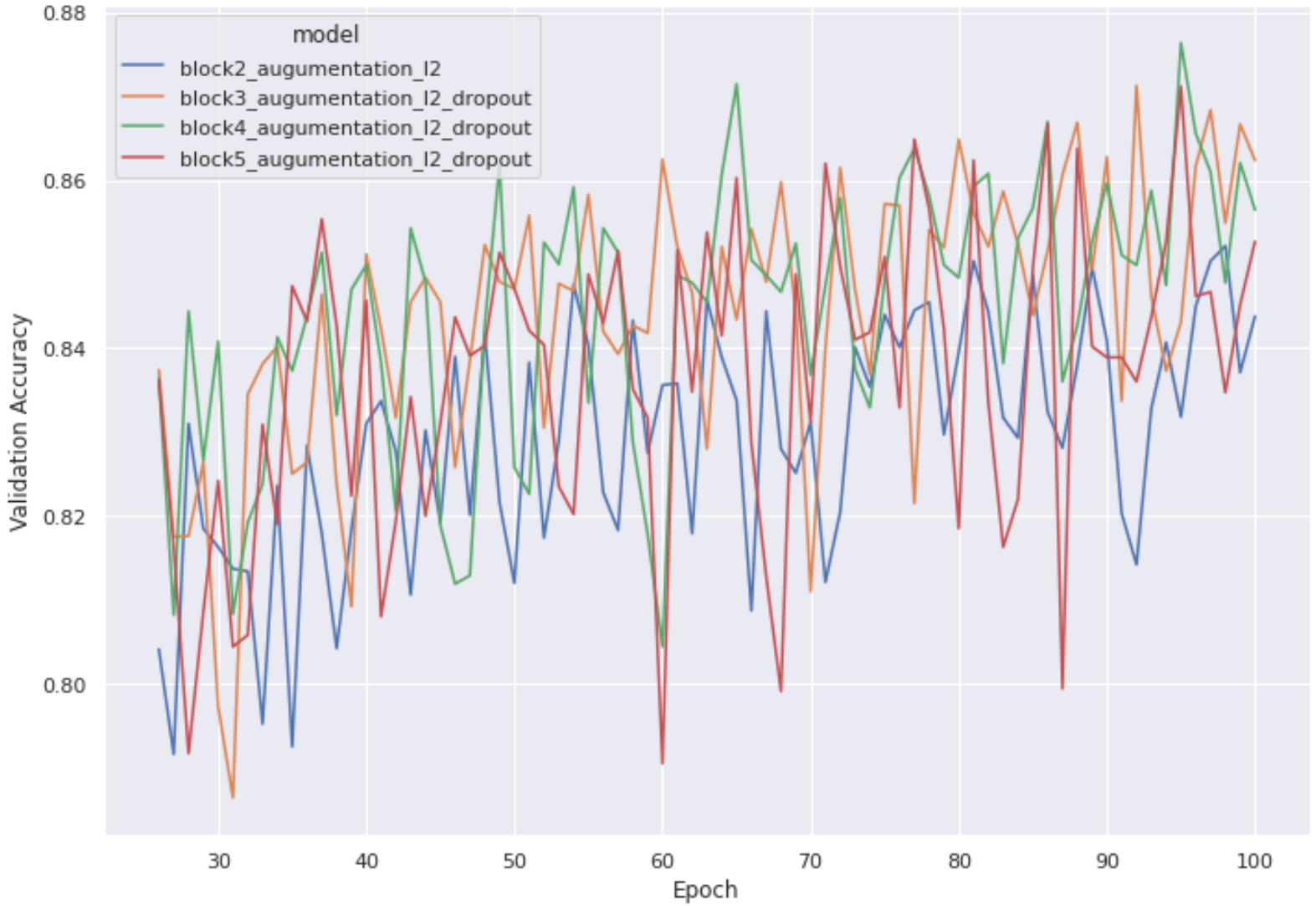

Training Loss
Loss
Epochs
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0
20
40
60
80
100


Validation Loss
Loss
Epochs
0
20
40
60
80
100


Training Accuracy
Accuracy
Epochs
0.8
0.7
0.6
0.5
0.4
0
20
40
60
80
100


Validation Accuracy
Accuracy
Epochs
0
20
40
60
80
100

VGG nets

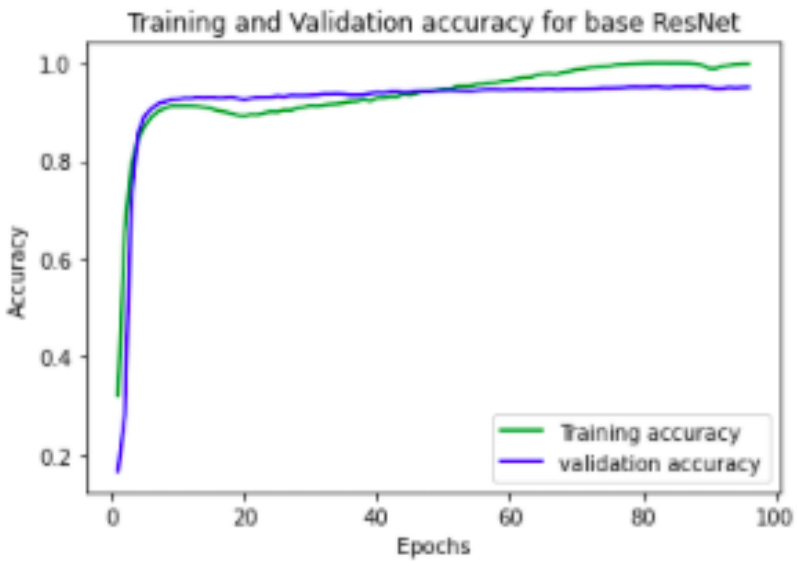

model
block2_augumentation_l2
block3_augumentation_l2_dropout
block4_augumentation_l2_dropout
block5_augumentation_l2_dropout
Validation Accuracy
0.88
0.86
0.84
0.82
0.80
30
40
50
60
70
80
90
100
Epoch

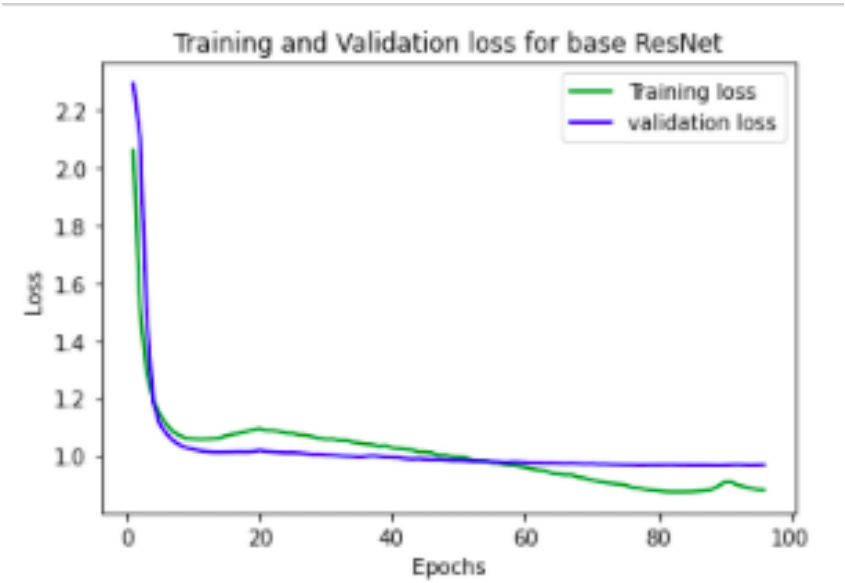
VGG nets

Submission and Description	Private Score
submission.csv 5 minutes ago by Werner add submission details	0.85160

Basic ResNet

- 3 layers: residual - convolutional - residual.
- Little data augmentation: cropping and whitening.

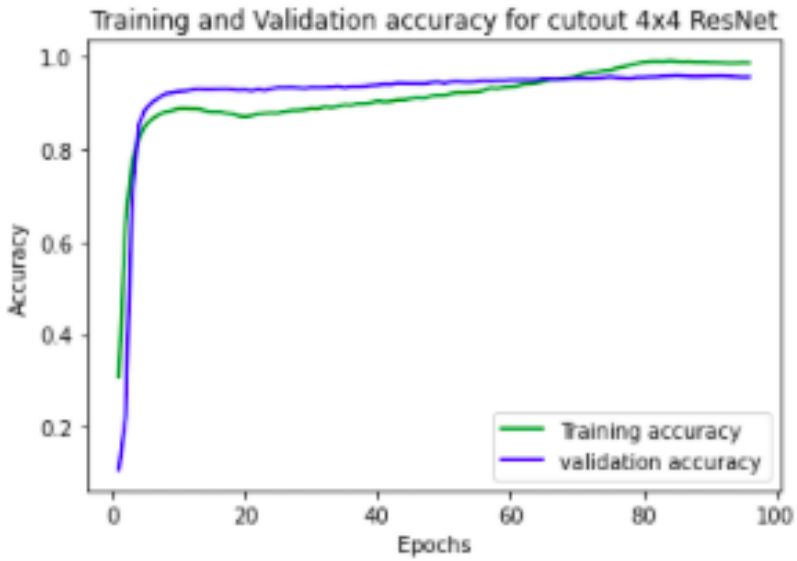


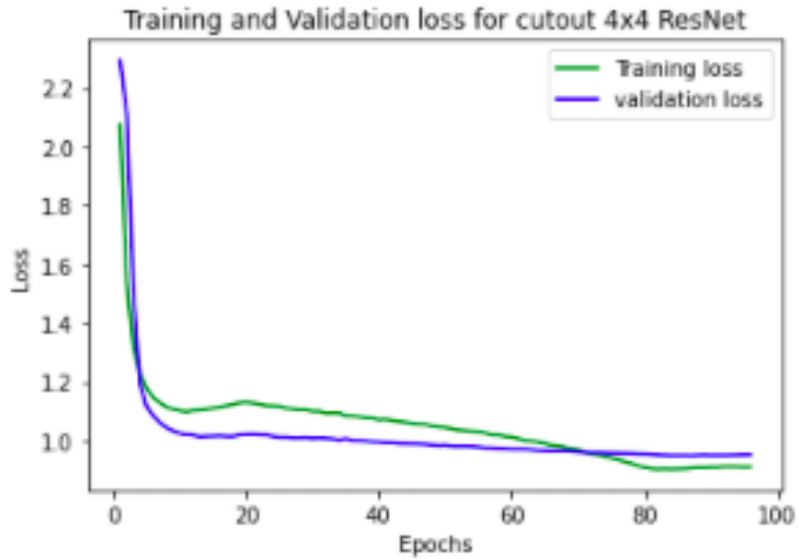


Rysunek: Accuracy and loss for the basic 3-layer ResNet.

ResNets with different data augmentation

- Added: flipping.
- Added: cutout 4x4.

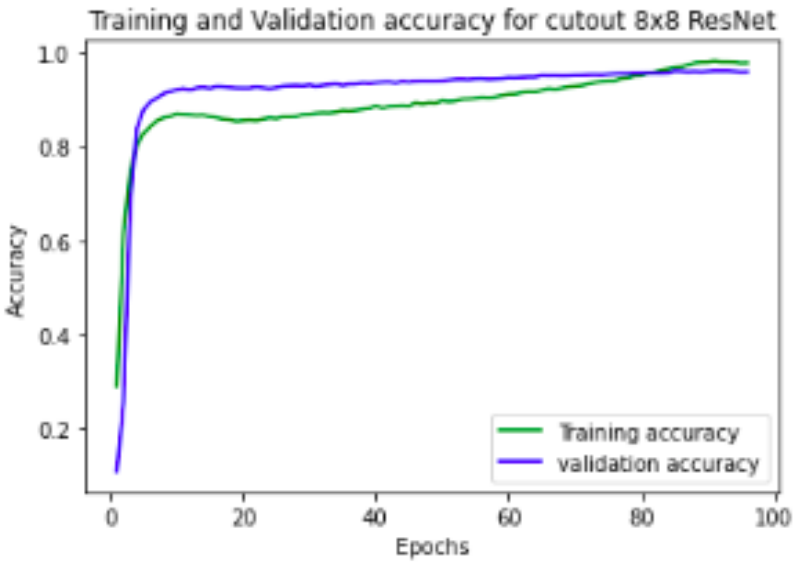


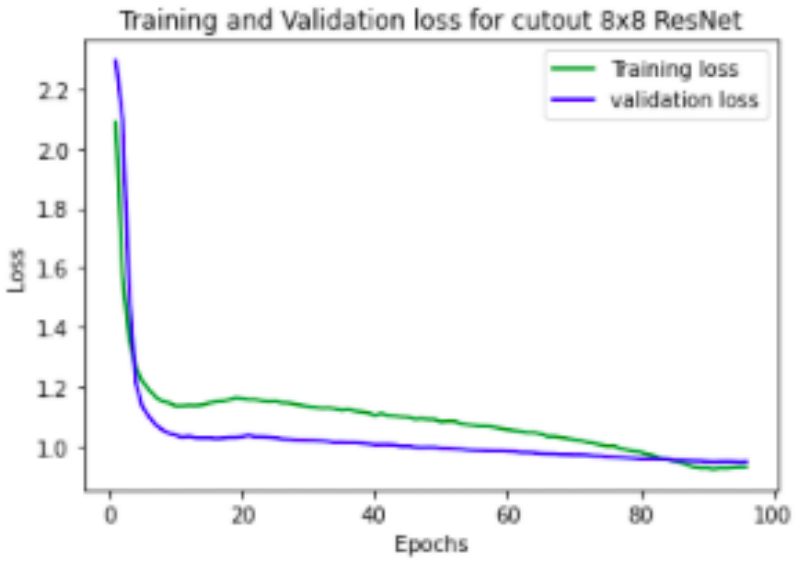


Rysunek: Accuracy and loss for a 3-layer ResNet with cutout 4x4.

ResNets with different data augmentation

- Added: flipping.
- Added: cutout 8x8.

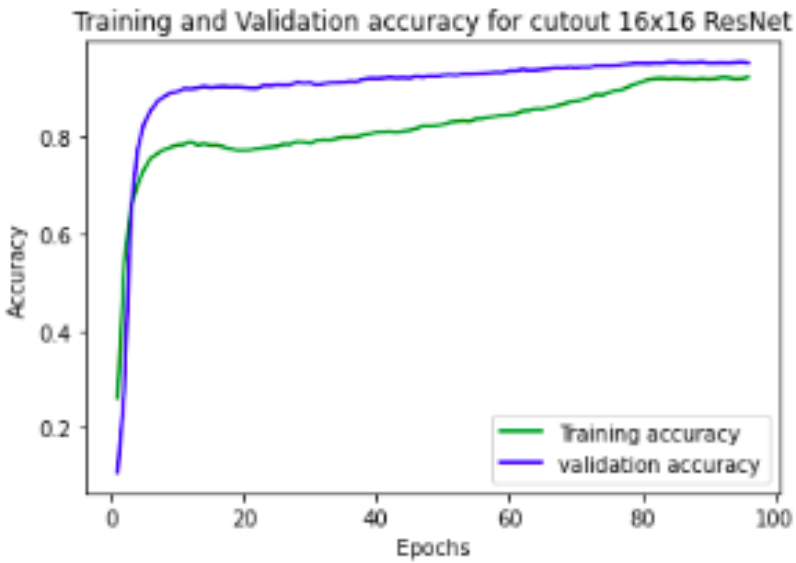


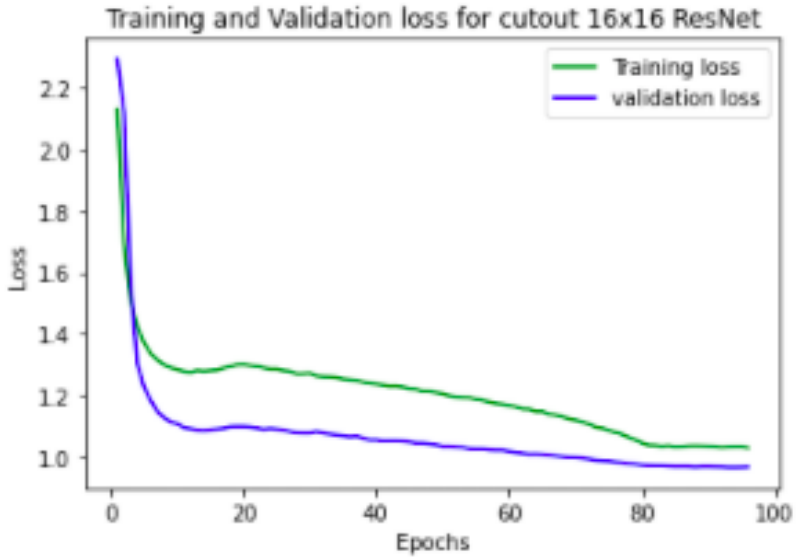


Rysunek: Accuracy and loss for a 3-layer ResNet with cutout 8x8.

ResNets with different data augmentation

- Added: flipping.
- Added: cutout 16x16.

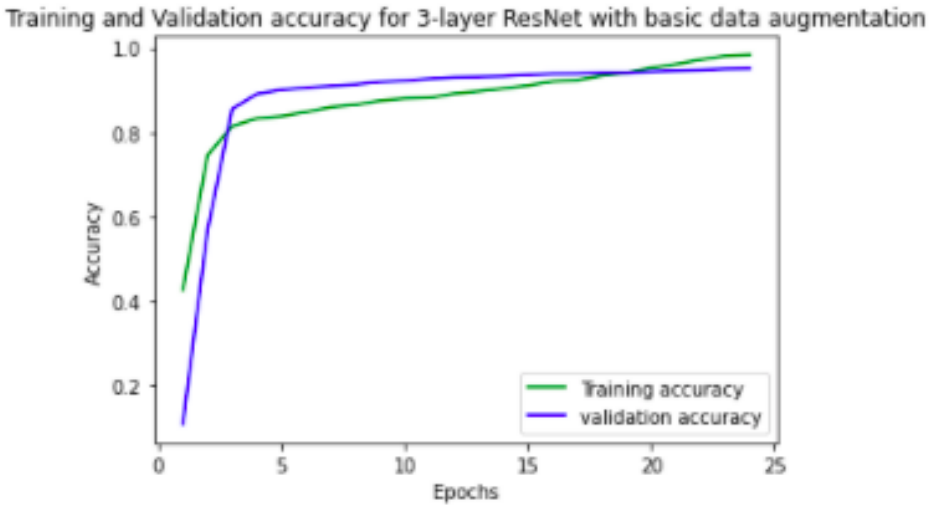


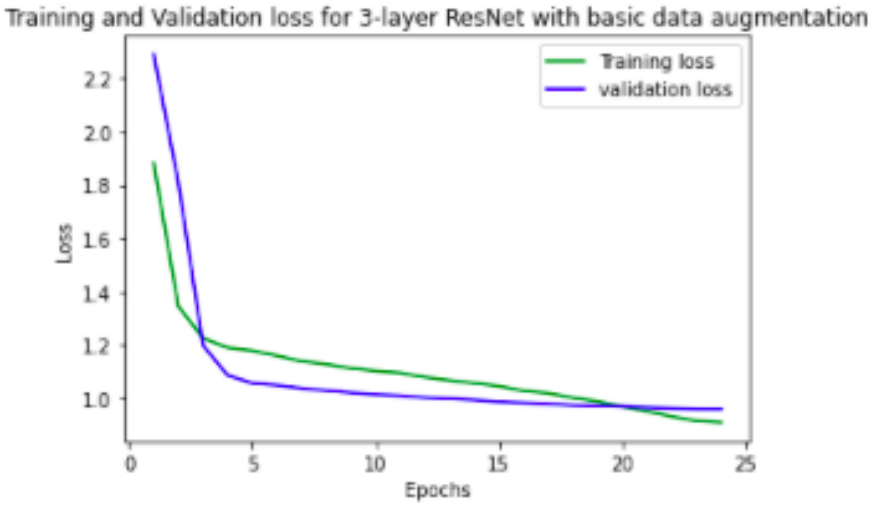


Rysunek: Accuracy and loss for a 3-layer ResNet with cutout 16x16.

ResNets with different architectures

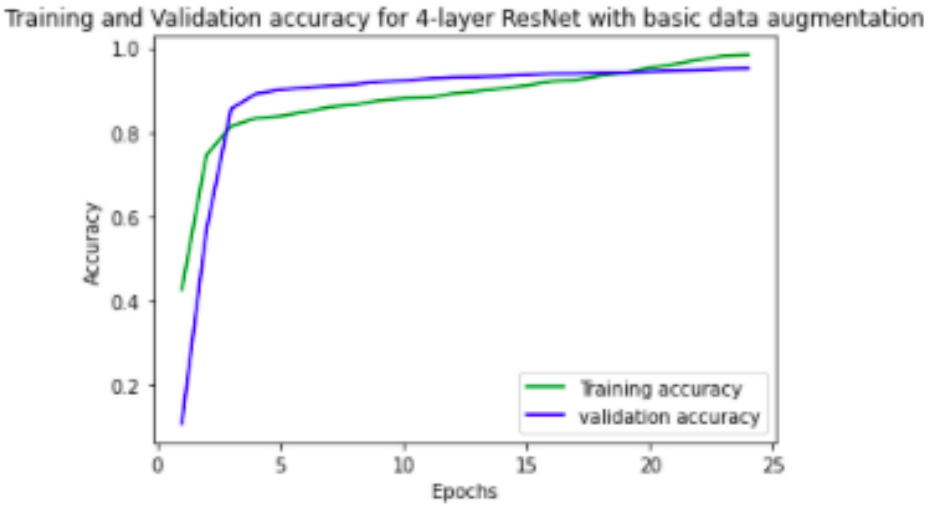
- Data augmentation: cropping and flipping.
- Adding one layer at a time.

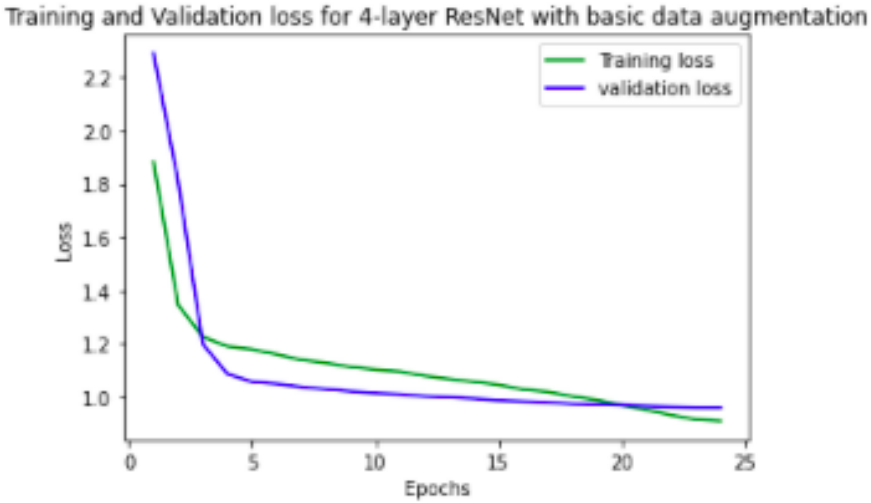




ResNets with different architectures

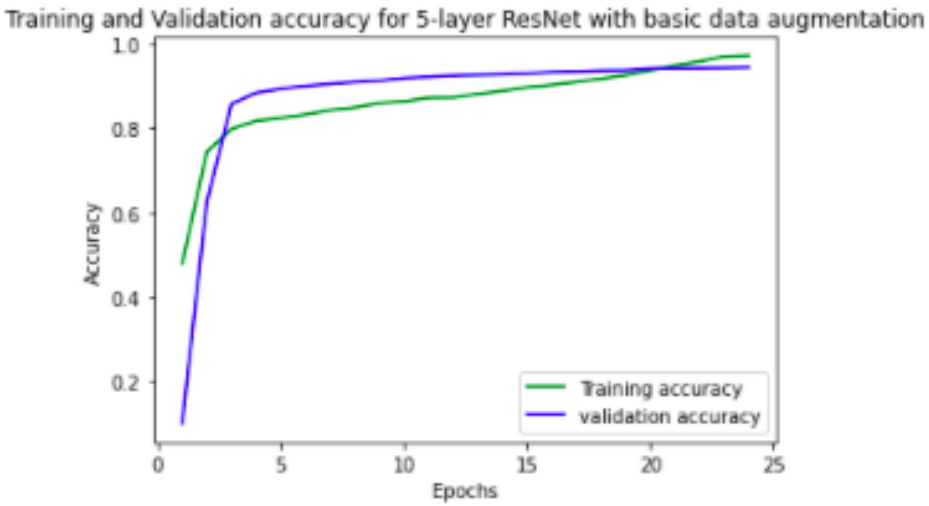
- Data augmentation: cropping and flipping.
- Adding one layer at a time.

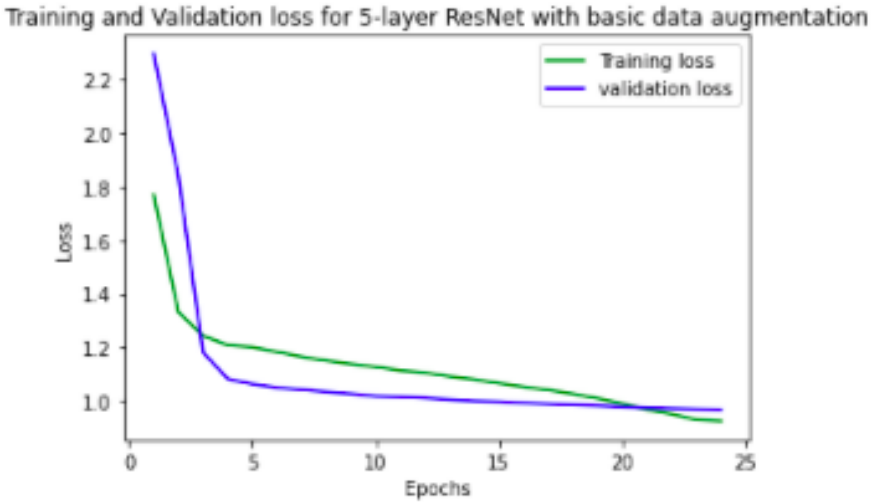




ResNets with different architectures

- Data augmentation: cropping and flipping.
- Adding one layer at a time.

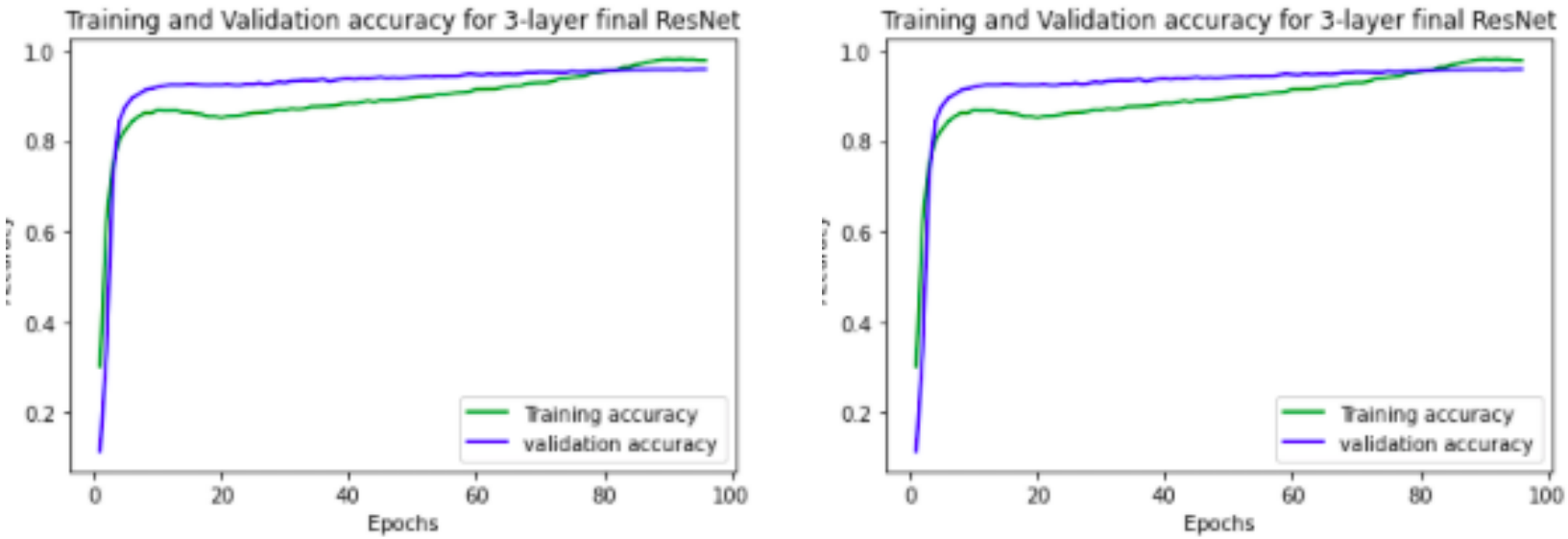




Rysunek: Accuracy and loss for a 5-layer ResNet

Final models

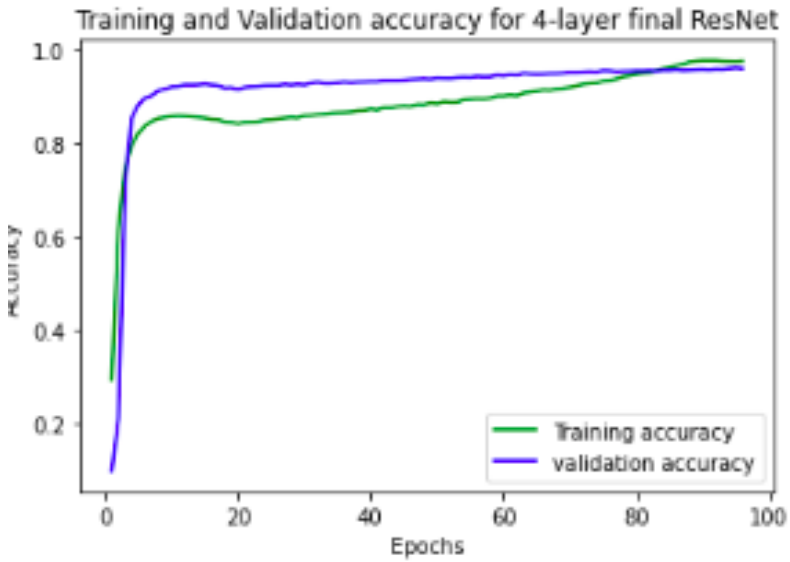
- Data augmentation: cropping, flipping and cutout 16x16.
- Adding one layer at a time.

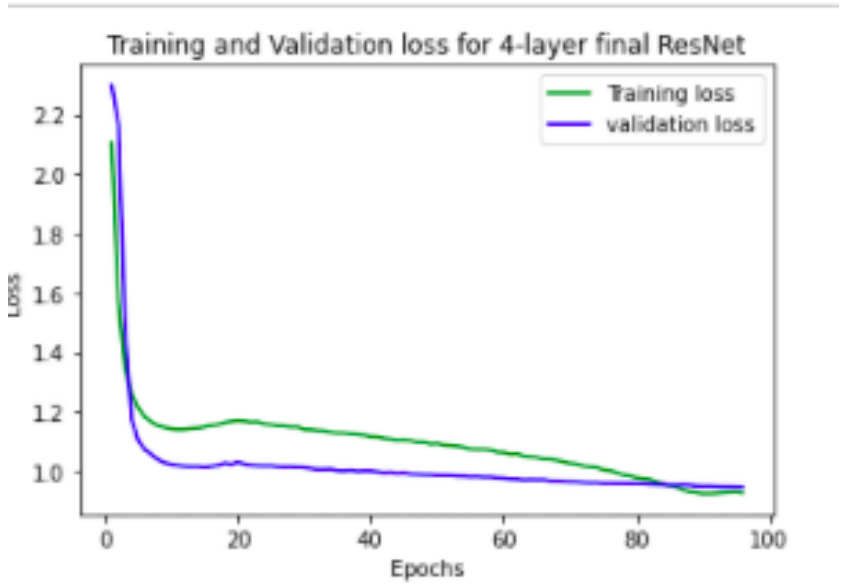


Rysunek: Accuracy and loss for a 3-layer ResNet with cutout

Final models

- Data augmentation: cropping, flipping and cutout 16x16.
- Adding one layer at a time.

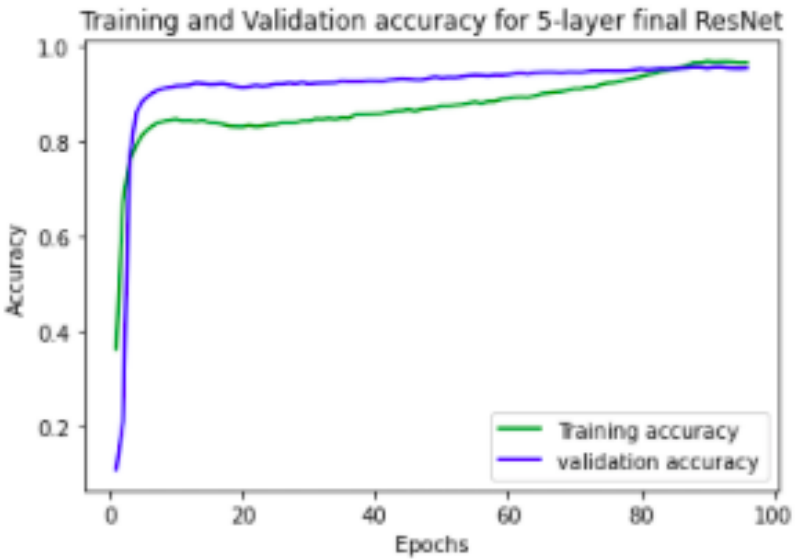


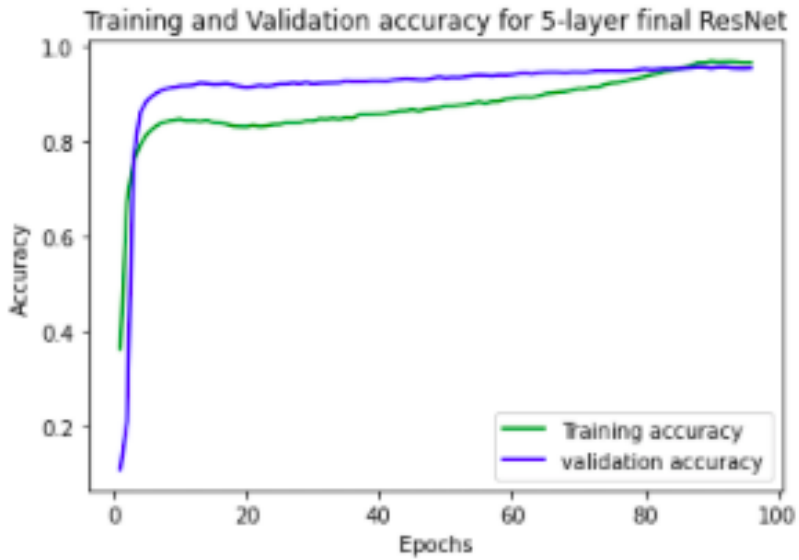


Rysunek: Accuracy and loss for a 4-layer ResNet with cutout

Final models

- Data augmentation: cropping, flipping and cutout 16x16.
- Adding one layer at a time.





Rysunek: Accuracy and loss for a 5-layer ResNet with cutout